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Maryamsadat Hosseini, Junichi Koike



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Amorphous CoTi_x as a liner/diffusion barrier material for advanced copper metallization

Maryamsadat Hosseini and Junichi Koike*

Department of Material Science, Tohoku University, Sendai 980-8579, Japan

Abstract—

This paper reports the possibility of using an amorphous Co-Ti alloy as a single-layer liner/barrier material for multilayer Cu interconnects in advanced silicon devices. Theoretical and experimental results both showed a stable composition range of an amorphous phase at room temperature to be Co-18 to 83 at% Ti. Liner/barrier property was investigated using sputtered films of Cu (150 nm)/ CoTi_x (3 nm) on thermal SiO_2 /p-Si substrates, where $x=25\pm 3$ at%Ti. The CoTi_x layer was found to enhance adhesion between Cu and SiO_2 . The CoTi_x layer stayed amorphous after annealing at 400 °C, and started to crystallize at 500 °C. The crystallization accompanied the dissociation of CoTi_x , leading to the formation of Ti oxide and Cu-Co solid solution. Capacitance-voltage measurement of the samples showed no interdiffusion of Cu ions into SiO_2 after annealing at 600 °C and after bias temperature annealing at 250 °C at 3 MV/cm. The results indicated that the CoTi_x alloy would be a good candidate for a single-layer liner/barrier material to replace a double-layer Ta/TaN.

Keywords— LSI, Interconnection, Diffusion barrier, Amorphous, Co alloy

AUTHOR INFORMATION

Corresponding Author:

*TEL/FAX: +81-22-795-7360. E-mail: koikej@material.tohoku.ac.jp.

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